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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/414,520	10/08/1999	KAZUE TAKAHASHI	503.37698X00	3400

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EXAMINER
ZERVIGON, RUDY

ART UNIT	PAPER NUMBER
1763	12

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Please find below and/or attached an Office communication concerning this application or proceeding.

Group I w/t → Appl. 8/19/02

Office Action Summary

Application No.	Applicant(s)
09/414,520	Takahashi et al
Examiner	**Art Unit**
Rudy Zervigon	1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Dec 28, 2001*

2a) ☐ This action is **FINAL.** 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1, 2, 4-7, 9, and 10* is/are pending in the applica

4a) Of the above, claim(s) _____ is/are withdrawn from considera

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1, 2, 4-7, 9, and 10* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirem

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____

18) ☐ Interview Summary (PTO-413) Paper No(s). _____

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

DETAILED ACTION

Continued Prosecution Application

1. The request filed on January 3, 2002 for a Continued Prosecution Application (CPA) under 37 CFR 1.53(d) based on parent Application No. 09/414,520 is acceptable and a CPA has been established. The after final amendment filed December 3, 2001 under 37 CFR 1.116 is entered. An action on the CPA follows.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1, 2, 4-7, 9, and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Each of independent claims 1 and 6 require an "insulating film". It is uncertain if the film insulates electrically or thermally.

Claim Rejections - 35 USC § 103

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 1, 2, 4-7, 9, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Satou et al (U. S. Pat. 5,961,850) in view of H. Nishino et al. Satou et al describes:

i. a plasma processing apparatus (Figure 1, column 2, lines 32-58) having a vacuum processing chamber (Figure 1, item 10, column 3, lines 10-15)

ii. a sample table (Figure 1, item 11, column 2, lines 32-58) for mounting the sample (Figure 1, item 13, column 2, lines 32-58) which is processed in the vacuum processing chamber

iii. a plasma generation means (Figure 1, column 2, lines 45-52), wherein a plasma etching (column 2, lines 59-67; column 4, lines 32-36) of an "insulating" film (column 5, line 11) is carried out by generating a plasma in response to introduction of a gas (column 2, lines 59-62) which generates a plasma in which the degree of plasma dissociation is a "middle" degree

iv. A temperature of a region (items 36, 37; column 2, lines 52-58) which forms a side wall of the vacuum processing chamber is controlled to have a range of 10 °C to 120 °C (column 3, lines 10-21)

v. electron energies are affixed under corresponding energies as per the Boltzman relationship: $E = (2/3)kT$

vi. plasma generation means (Figure 1, column 2, lines 47-51)

vii. A plasma processing (column 2, lines 59-67) apparatus wherein in the plasma generation means includes a drive of a plasma exciting power supply carried out intermittently ("frequency" of item 12 and the microwave power application means - column 2, lines 39-48)

viii. A plasma processing (column 2, lines 59-67) apparatus wherein as a means for adjusting a temperature of the vacuum wall, a temperature adjusted coolant (column 3, lines 22-23) medium is used.

Satou et al does not specifically describe:

ix. A gas which contains at least carbon and fluorine and a gas species is generated which contains carbon and fluorine according to a plasma dissociation

x. plasma generation means which generates a plasma in which the degree of plasma dissociation is a "middle" degree and the gas species containing carbon and fluorine is generated fully in the plasma

H. Nishino et al demonstrate:

xi. A gas which contains at least carbon and fluorine ("CF_4", Sections II & III.A), and a gas species is generated which contains carbon and fluorine according to a plasma dissociation

xii. the plasma processing apparatus (Figure 1) comprising plasma generation means (Figure 1, 2.45GHz microwave) which generates a plasma in which the degree of plasma dissociation is a "middle" degree and the gas species containing carbon and fluorine ("RIE", Section III.A) is generated fully in the plasma

It would have been obvious to one of ordinary skill in the art at the time the invention was made to implement H. Nishino et al's fluoromethane ("CF_4", Sections II & III.A) as Satou et al's "etchant" gas (column 2, lines 59-62).

Motivation for implementing H. Nishino et al's fluoromethane ("CF_4", Sections II & III.A) as Satou et al's "etchant" gas is drawn from common industrial practices, and more specifically, as discussed by H. Nishino et al, the gas can be used when "rough Si surfaces can be smoothed and Si trench corners can be rounded off ..." (abstract).

Satou et al does not describe the precise frequency of microwave application as being between 300MHz and 1GHz. H. Nishino et al describes a microwave plasma apparatus with 2.45GHz microwave (Section II.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to reduce the microwave frequency power application, as taught by H. Nishino et al, in order to impart the desired extent of dissociation.

Motivation for reducing the microwave frequency power application, as taught by H. Nishino et al, is to impart the desired extent of dissociation as is well known in the art. Furthermore Satou et al provides specific motivation for selecting alternative etching gasses as influencing "wafer yield stability and reliability" (column 5, lines 10-29).

With respect to the range of microwave frequency power applied for imparting an extent of dissociation of the process gas used, it has been held that "when the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." See MPEP 2144.05. In the present case, that Satou et al does not teach the precise frequency of microwave application as being between 300MHz and 1GHz does not impart a non-obvious facet of the presently claimed invention because those of ordinary skill in the art, holding all other parameters constant, would arrive at the prescribed frequency of microwave application depending on the process gas of choice as is known from the demonstration by Kuhn et al of the harmonic oscillator relationship[1] of a molecule's bonds and the its excitation frequency as given by:

$$\nu = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}}$$

Here, k represents the molecule's bond constant and μ is the reduced mass of the molecule. Both k and μ are each intrinsic properties of the molecule. The Examiner takes official notice (MPEP 2144.03) on the contention that changing the microwave dissociation frequency would be obvious to those of ordinary skill in the art as is known from the relationship above. Here, molecules with

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[1]Kuhn et al, "Principles of Physical Chemistry - Understanding molecules, molecular assemblies, supra molecular machines" John Wiley & Sons, Ltd., 1999, Pp289

weaker bonds (small k, such as C-F bonds) do not require an external driving frequency as large as molecules with stronger more covalent bonds (large k, C-C/C=C, etc..) for their dissociation.

Response to Arguments

6. Applicant's arguments filed December 6, 2001 have been fully considered but they are not persuasive.

7. The position that apparatus claims 1, 2, 4, and 5 are distinguished from the prior art because the apparatus of the prior art does not teach "a gas species is generated which contains carbon and fluorine according to a plasma dissociation" is not convincing. It has been held that apparatus claims must distinguish from the prior art in terms of structure rather than processing conditions. Refer to MPEP 2114. In this case, processing conditions such as the particular gas used does not distinguish the apparatus claims so long as the apparatus is capable of forming a plasma as does the apparatus described by Satou et al (ESPIED. 5,961,850) as conveyed in this and the prior Office Actions.

8. The position that method claims 6, 7, 9, and 10 are distinguished from the prior art because the method of the prior art does not teach "a gas species is generated which contains carbon and fluorine according to a plasma dissociation" is also not convincing. Although Satou et al (ESPIED. 5,961,850) does not teach a carbon and fluorine containing plasma, that H. Nishino et al does teach a carbon and fluorine containing plasma and provides motivation for such species, the question of obviousness to those of ordinary skill in the art is established prima face. Accordingly -

Motivation for implementing H. Nishino et al's fluoromethane ("CF_4", Sections II & III.A) as Satou et al's "etchant" gas is drawn from common industrial practices, and more specifically, as discussed by H. Nishino et al, the gas can be used when "rough Si surfaces can be smoothed and Si trench corners can be rounded off ..." (abstract) .

9. That "the degree of plasma dissociation" is a feature that distinguishes the present application from the prior art is not convincing. This argument is addressed above in paragraph 12 with regards to apparatus claims 1, 2, 4, and 5 and method claims 6, 7, 9, and 10. The extent of plasma dissociation or ionization is characterized by, for example, Satou et al where a gas flow controller would influence the extent of the ionized plasma (column 4, lines 34-36) - with a constant energy applied to the plasma at constant temperature, the introduction of unionized process gas via the gas flow controller would reduce the overall extent of ionization as is known to those of ordinary skill in the art.

10. Satou et al specifically demonstrates the inventive concept of the present invention as gleaned from applicant's position that "...the low temperature of 10°C to 120°C for a side wall of the vacuum processing chamber serves to limit the amount of gas discharge from reaction products that become deposited on the side wall. The range of 10°C to 120°C is selected as being significantly lower than the desorption temperature of the reaction products." - here Satou et al teaches a reaction product, in this case aluminum chloride, that solidifies at 100°C and is "deposited when the inner sidewall of the processing chamber of the plasma processing apparatus of Fig.1 is lower than 100°C ", further, "...by setting the inner sidewall of the processing chamber at 100°C or more than 100°C

....it is possible to prevent the reaction products from adhering to the inner sidewall of the processing chamber...minimizing the possibility of foreign matter falling onto the surface of the wafer" (column 3, lines 35-58).

11. With regards as to Applicant's citation that Satou et al seeks to "prevent" the deposition of process materials on the chamber wall, it is a question of selecting the desired temperature setting (column 3, lines 10-21) of the wall heating elements for the specific gas used (column 5, lines 10-21) for controlling the amount of deposition and evaporation on/from the wall of the reactor.

12. With regards as to Applicant's citation that Satou et al only describes cooling "downstream from the processing chamber area" is inaccurate with respect to all Figures of the Satou et al reference. Moreover, cooling is effected in the Satou et al through conduction via the chamber wall components.

13. H. Nishino et al precisely teach the usage of process gasses that provide carbon and fluorine a plasma gas species ("CF_x" - Section III.A).

14. Applicant's position that "there is no desirability of achieving lesser degree of dissociation ..." is inaccurate in view of H. Nishino et al who precisely relates the etching, via RIE, of "silicon oxide" (see section I, second and third paragraphs) wherein gas species such as CF and CF_2 are desirable ("CF_x" - Section III.A) and provides motivation for the presence of "CF_x" where *etch rates* of the substrate are controlled (see Section III.A).

Conclusion

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 872-9311. The official before final fax phone number for the 1763 art unit is (703) 872-9310. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.

GREGORY MILLS
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